

TP-024-087

Revision 0

DATA COLLECTION FOR E DIESEL GENERATOR
COMBUSTION INTAKE AIR TEMPERATURE TEST

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1.0 PURPOSE

To provide a controlled method for coordinating the "E" diesel operation and ESW flow to the E diesel generator intercoolers to enable engine balancing and collection of combustion air intake temperatures.

2.0 DISCUSSION

As a result of the ongoing investigation into the root-cause of the recent diesel generator crankcase explosions an area of concern is, what impact does combustion intake air temperature have on diesel operation.

Per the manufacturers specifications this test will increase combustion intake air temperature to within a range of 105-110°F. At this temperature an engine analyzer will be utilized to measure parameters such as cylinder peak firing pressure, firing angle and horsepower. A review of this data will determine if the E Diesel Generator is properly balanced. If necessary engine adjustments will be performed and another engine analyzer data collection will be performed. This process will be repeated until the diesel is considered to be balanced. Upon obtaining a balanced diesel the ESW flow thru the diesel intercoolers will be increased and measured until certain intake air temperatures are obtained. Finally the ESW flow through the intercoolers will be returned to its normal status (i.e., inlet valve full open) and an engine analyzer run will be performed. The data from this final analyzer run will be compared to the previous analyzer runs to determine the characteristics of engine operation with respect to intake air temperature.

Presently the ESW Inlet Valve to the E Diesel Generator Intercoolers is Full Open. Therefore, by throttling in the closed direction during this test, more flow will be directed to the other components supplied by ESW. As a result, if affected, the flows to other components supplied by ESW will be conservatively affected.

3.0 REFERENCES

- 3.1 Unit 1 and 2 Technical Specification 3.8.1.1 Action b
- 3.2 Unit 1 and 2 Technical Specification 4.8.1.1.2.a.4
- 3.3 Unit 1 Technical Specification 3.8.1.1 Action d
- 3.4 AD-QA-422, Surveillance Testing Program
- 3.5 OI-024-002, Diesel Generator Start Log
- 3.6 OP-024-001, Diesel Generators

3.7 TI-PE-009, Test Procedures

3.8 Cooper Bessemer Document QCG-6724, Power Cylinder Load Balance Procedure

3.9 MT-024-024, Diesel Engine Analysis and Load Balancing

4.0 TEST EQUIPMENT

4.1 Engine Analyzer (anyone of the following) (1)

a. EN SPEC 1000

b. EN SPEC 3000

c. BETA 250

4.2 Ultra Sonic Flow Detectors - Model DHT-P or equivalent (1)

4.3 C-clamps 2-3" (2)

4.4 One (1) ΔP gage capable of reading up to 3000 gpm flow at FE-01112E

5.0 PRECAUTIONS

5.1 Do not parallel the generator to the bus out of phase or equipment damage will occur.

5.2 Do not exceed a steady state voltage limit of 4400 volts.

5.3 Do not exceed a short term 2-hour rating of 5500 kw (nominal) or a continuous 5000 kw and 867 ampere rating.

5.4 At Local Panel OC519E observe that kvars remain between ± 1500 kvars but as close to 0 as possible, when the generator is paralleled.

5.5 Do not attempt to restart an engine after an automatic shutdown occurs or if an overheating condition exists, until the problem is found and corrected.

6.0 PREREQUISITES

- 6.1 No maintenance or other testing is being performed or planned on the E diesel generator and its associated auxiliary systems that would affect this test.

_____/_____
Confirmed By Date

- 6.2 The remaining operable diesel generators are aligned in standby, are not under test and are not scheduled for testing during performance of this procedure.

_____/_____
Confirmed By Date

- 6.3 ENSURE E diesel generator is available for operation in the test mode and not required for substitution for the A-D D/G's.

_____/_____
Confirmed By Date

- 6.4 INSTALL a ΔP gage at FE-01112E which is capable of reading a ΔP equivalent to 3000 gpm at FE-01112E. RECORD instrument calibration data on Attachment E.

_____/_____
Confirmed By Date

- 6.5 Reliable means of communication is available between Control Room and diesel generator E bay in test.

_____/_____
Confirmed By Date

- 6.6 Mechanical Maintenance Department has been notified that diesel testing is to be conducted.

NOTIFIED?

YES/NO
(Circle One)

_____/_____
Confirmed By Date

- 6.7 Personnel are available to take hourly diesel generator readings using the operating log provided in OI-024-004.

_____/_____
Confirmed By Date

- 6.8 Fuel oil, sampled and accepted by Chemistry, is available to replenish the diesel oil storage tanks.

WA # _____
Confirmed By _____ / _____
Date

- 6.9 Qualified personnel available to operate engine analyzer.

Confirmed By _____ / _____
Date

- 6.10 ENSURE ESW is operating in accordance with OP-054-001 Section 3.2, to support the operation of the E diesel in the Test Mode.

Confirmed By _____ / _____
Date

- 6.11 Electrical Maintenance is available to support this test.

Confirmed By _____ / _____
Date

- 6.12 INFORM Unit 1 and Unit 2 Supervisors that diesel testing will be performed.

Confirmed By _____ / _____
Date

- 6.13 Severe weather conditions which could affect offsite power stability are not predicted.

Confirmed By _____ / _____
Date

- 6.14 All test personnel have been properly briefed.

Confirmed By _____ / _____
Date

- 6.15 Surveillance Requirement 4.8.1.1.2.a.4 has been performed on the Standby Diesel Generators, if applicable.

Confirmed By _____ / _____
Date

7.0 PROCEDURE

NOTE (1): Attachment A is for Test Control Documentation and is used for the identification or amplification of any information that is considered appropriate by the Test Director for the evaluation of this test. It is also used for recording date and time of a test suspension and last step completed prior to a test suspension and test restart information.

NOTE (2): In Section 7.1 the loading times and power increments are to be adhered to in the order delineated. But, the level of power to which the machine is ultimately increased to, will be at the discretion of the test director.

7.1 Diesel Generator Start and Warmup

- 7.1.1 START Diesel Generator E in accordance with OP-024-004
"Operation of E Diesel Generator in Test Mode."

_____/_____
Confirmed By Date

- 7.1.2 OPERATE Diesel Generator E unloaded for 15 minutes.

_____/_____
Confirmed By Date

- 7.1.3 SYNCHRONIZE Diesel Generator E to transformer OX207 from
OC619 in accordance with OP-024-004 section 3.3, Operation of
Diesel Generator E in Test Mode.

_____/_____
Confirmed By Date

- 7.1.4 INCREASE Diesel Generator E load to 1250 kw and operate for
30 minutes.

_____/_____
Confirmed By Date

- 7.1.5 INCREASE Diesel Generator E load to 2500 kw and operate for
30 minutes.

_____/_____
Confirmed By Date

- 7.1.6 INCREASE Diesel Generator E load to 3750 kw and operate for 30 minutes.

Confirmed By / Date

- 7.1.7 INCREASE Diesel Generator E load to 5000 kw and operate for 60 minutes.

Confirmed By / Date

7.2 Engine Analyzer and Intake Air Temperature Data Collection

NOTE: In Section 7.2 of this procedure the steps must be performed in the order delineated but which power levels and what data to be taken at these levels can be determined per the discretion of the test director.

- 7.2.1 RECORD the requested data under Column #1 of Attachment B.

Confirmed By / Date

- 7.2.2 PERFORM Engine Analyzer data collection per MT-024-024.

Confirmed By / Date

- 7.2.3 REDUCE Diesel Generator E Load to 4000 KW.

Confirmed By / Date

NOTE: When throttling ESW Flow with valve 011501 C-clamps may be required to maintain valve in desired position.

- 7.2.4 THROTTLE ESW Inlet to E D/G Intercoolers Valve 011501 in the closed direction until an intake air temperature of 105-110°F is obtained in both intake manifolds.

Confirmed By / Date

- 7.2.5 RECORD the requested data under Column #2 of Attachment B.

Confirmed By / Date

- 7.2.6 After at least 30 minutes of operation at 4000 KW, PERFORM Engine Analyzer data collection and adjust engine parameters as necessary to balance the engine per MT-024-024.
- _____/_____
Confirmed By Date
- 7.2.7 Once the E Diesel Generator has been determined balanced, ENSURE both intake air temps are 105-110°F and RECORD the requested data under Column #3 of Attachment B.
- _____/_____
Confirmed By Date
- 7.2.8 PERFORM Engine Analyzer data collection per MT-024-024.
- _____/_____
Confirmed By Date
- 7.2.9 INCREASE Diesel Generator E load to 5000 KW.
- _____/_____
Confirmed By Date
- 7.2.10 ENSURE both Intake Air Manifold Temperatures are 105-110°F and RECORD the requested data under Column #4 of Attachment B.
- _____/_____
Confirmed By Date
- 7.2.11 After at least 30 minutes of operation at 5000 KW, PERFORM Engine Analyzer data collection per MT-024-024.
- _____/_____
Confirmed By Date
- 7.2.12 ENSURE Diesel remains balanced per MT-024-024, if not, balance diesel per MT-024-024.
- _____/_____
Confirmed By Date
- 7.2.13 THROTTLE valve 011501, ESW Inlet to E D/G Intercoolers, until the intake air in each manifold is between 65-75°F.
- _____/_____
Confirmed By Date

7.2.14 RECORD the requested data under Column #5 of Attachment B.

Confirmed By / Date

7.2.15 RETURN valve 011501, ESW Inlet to E D/G Intercoolers, to the Full Open Position and RECORD data requested in Column #6 of Attachment B.

Confirmed By / Date

7.2.16 PERFORM Analyzer data collection per MT-024-024.

Confirmed By / Date

7.2.17 REDUCE Diesel Generator E load to 2500 KW.

Confirmed By / Date

7.2.18 RECORD the requested data under Column #7 of Attachment B.

Confirmed By / Date

7.2.19 After at least 30 minutes of operation at 2500 KW, PERFORM Engine Analyzer data collection per MT-024-024.

Confirmed By / Date

7.2.20 If during the performance of this procedure adjustments have been made to the diesel generator then perform SO-024-001E to declare the E Diesel Generator operable. If no adjustments made then N/A.

Confirmed By / Date

7.2.21 REMOVE and Shutdown Diesel Generator E from the test mode in accordance with OP-024-004 Section 3.3.

Confirmed By / Date

- 7.2.22 INFORM Shift Supervision upon completion of this procedure and that the testing diesel generator can be returned to service.

_____/_____
Confirmed By Date

8.0 RESTORATION

- 8.1 REMOVE Δ P gage at FE-01112E, installed per step 6.4.

_____/_____
Confirmed By Date

_____/_____
Verified By Date

- 8.2 ENSURE ESW Inlet to E D/G Intercoolers, valve 011501 is LOCKED in Full Open Position.

_____/_____
Confirmed By Date

_____/_____
Ind. Verified By Date

- 8.3 ENSURE required Post Calibration Data Recorded on Attachment E.

_____/_____
Confirmed By Date

9.0 ACCEPTANCE CRITERIA

This procedure is intended only to collect data. Therefore, the information collected in Attachment A and MT-024-024 shall be evaluated to determine the appropriate actions relative to Combustion Air Intake Temperature.

10.0 REVIEW

- 10.1 This test has been reviewed in conjunction with MT-024-024 by the Technical Staff Electrical Group Supervisor.

_____/_____
Elect. Group Supv. Date

10.2 This test has been reviewed in conjunction with MT-024-024 by the Maintenance Diesel Engineer.

_____/_____
Maint. Diesel Eng. Date

11.0 RECORDS

Completed TP transmitted to DCC via Transmittal Form 3179 to File R48-1 and cross referenced to file S024.

_____/_____
Confirmed By Date

Attachment A
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TEST CONTROL DOCUMENTATION SHEET

Sheet ____ of ____

COMMENT NO.

COMMENT

INITIAL/DATE

DATA COLLECTION TABLE

	<u>Col 1</u>	<u>Col 2</u>	<u>Col 3</u>	<u>Col 4</u>	<u>Col 5</u>	<u>Col 6</u>	<u>Col 7</u>
1) Temperature Manifold LT Pt. 5 TI-03418E (OC521E)	_____	_____	_____	_____	_____	_____	_____
2) Temperature Manifold RT Pt. 6 TI-03418E (OC521E)	_____	_____	_____	_____	_____	_____	_____
* 3) ESW Flow at FI-01112E	_____	_____	_____	_____	_____	_____	_____
* 4) ESW Flow Upstream of Valve 011501 (Interclg)	_____	_____	_____	_____	_____	_____	_____
* 5) ESW Flow Upstream of Valve 011507 (Jkt. Wtr)	_____	_____	_____	_____	_____	_____	_____
* 6) ESW Flow Upstream of Valve 011506 (F. D.)	_____	_____	_____	_____	_____	_____	_____
* 7) ESW Flow Upstream of Valve 011508 (L. D.)	_____	_____	_____	_____	_____	_____	_____
** 8) ESW Avg. Spray Pond Temp.	_____	_____	_____	_____	_____	_____	_____
9) Denote Position of Valve 011501 (# of Notches from full open)	_____	_____	_____	_____	_____	_____	_____
10) Record Outside Air Temp from PMS Meterological Format	_____	_____	_____	_____	_____	_____	_____

* NOTE: To obtain flows for Items 3, 4, 5, 6 and 7 use Attachment C.

** NOTE: Calculate and Record Avg. ESW Spray Pond Temp as shown in Attachment D.

DIESEL GENERATOR FLOWS

(E - D/G)

[illegible]

NOTES:

- 1) To determine E D/G Actual Flow (total) reference flow characteristics curve for FE-01112E, transpose gpm readings onto Attachment B, Step 4.
- 2) UI Velocities are expressed in feet per second (fps)
- 3) $UT \text{ Flows} = UT \text{ Velocity Reading} \times$
 - 79.4 gpm/fps for Lube Oil & Intercooler
 - 35.0 gpm/fps for Jacket Wtr. Clr
 - 5.5 gpm/fps for Fuel Oil Clr
- 4) Total UI Flow = Summation of UI Flows for Lube Oil, Intercooler, Jacket Wtr and Fuel Oil Coolers
- 5) Weighted Avg = UI Flow (for each cooler) / Total UI Flow for D/G E (Note 4)
- 6) Actual Flow = E D/G Actual Total Flow (Note 1) \times Weighted Avg for each cooler (Note 5)

CALCULATION OF AVG ESW SPRAY POND TEMP

- A) Record following temperatures at Spray Pond Div. 2 (Panel OC529B) Spray Pond Temp (TI-01228B).

	<u>Col 1</u>	<u>Col 2</u>	<u>Col 3</u>	<u>Col 4</u>	<u>Col 5</u>	<u>Col 6</u>	<u>Col 7</u>
a. Surface Temp. (Pos. 5)	_____	_____	_____	_____	_____	_____	_____
b. Middle Temp (Pos. 4)	_____	_____	_____	_____	_____	_____	_____
c. Bottom Temp (Pos. 6)	_____	_____	_____	_____	_____	_____	_____
d. Compute Avg. Temp. a+b+c/3	_____	_____	_____	_____	_____	_____	_____

SPECIAL TOOLS/EQUIPMENT

<u>M&TE NO</u>	<u>TYPE</u>	<u>RANGE</u>	<u>CALIBRATION DATE</u>	<u>CALIBRATION DUE DATE</u>	<u>LOCATION OF INSTALLATION</u>	<u>INSTALLED IN STEP</u>
_____	see step 4.4	_____	_____	_____	FE-01112E	6.4